DOCUMENT RESUME

ED 206 710 TM 810 613

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TITLE The Development and Analysis of a Test in Life Science for Middle School Students.
PUB DATE [80]
NOTE 16p.; Colored pages may not reproduce clearly.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Difficulty Level; Grade 7; *Intermediate Grades; *Multiple Choice Tests; Natural Sciences; Pretests Posttests; *Science Tests; Scientific Concepts; *Scientific Literacy; Test Items; Test Reliability

ABSTRACT

It is suggested that most standardized science tests do not adequately assess the majority of concepts taught as part of the very diversified middle school science curriculum. The 50-item Life Science Test constructed by Portland Public Schools, Maine, herein presented, aims to resolve this inadequacy. The 40-minute multiple choice test incorporates items dealing with: science study skills; community relations; living and non-living factors in the environment; adaptation of the organisms to their environment; terrestrial and marine environment. Directions concerning test administration are provided for the test administrator and instructions for the student are incorporated in the test. The test was administered as a pretest and posttest to more than 300 grade 7 students. Appended to the test sample are the resulting reliability (standardized Alpha) estimates which range between .65 and .73, and a specification table which lists the number of items testing knowledge or recall and comprehension for each concept. (Author/AEF)

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The Development and Analysis of a Test in Life Science For Middle School Students

by

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U.S. DEPARTMENT OF EDUCATION
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Abstract

This fifty item test deals with science study skills, community relations, living and non-living factors in the environment, adaptation of the organisms to their environment, terrestrial and marine environment, etc.

The test was administered as a pre and post test to more than three hundred grade 7 students in the Fall of 1980. The reliability (standardized Alpha) estimates are somewhat low and range between .65 and .73. Results of item-analysis of the data are being made available to enable potential test users to make the needed revision.

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TM 810 613

SCIENCE TESTS

GRADE 7

1980-81 School Year

DIRECTIONS FOR THE TEST ADMINISTRATOR

Before Testing

1. Distribute the sheet consisting of the Table of Specifications a week before the administration of the test.

2. Have the student identification parts of the answer sheets completed before administering the test. One of the sides of the answer sheets contains an example. The side which does not have an example should be completed as follows:

   a. At the upper left corner, print the student name, school name, etc.

   b. Do not complete the student number box at the upper right corner of the answer sheet.

   c. On the right side, print the first initial, middle initial and last name, in the spaces provided.

During Testing

1. Make sure that the students do NOT write on the tests; student names, answers to test questions, etc., should be written on the IBM answer sheets provided.

2. Number 2 pencils must be used on the answer sheets.

3. Instruct the students to darken the space under the answer of their choice; if they change their minds, they should erase the first one completely.

4. Read the 'Note' in the beginning of the test and the directions which follow, to the students as they read those to themselves.

A LIFE SCIENCE TEST: Grade 7

Maximum Points: 50 Time: 40 Minutes

Directions: Please do not write anything on this test. Use the answer sheet provided. Select the best answer to the following questions and darken the spaces under the answers of your choice, by using number 2 pencils. If you change your mind, erase your first answer completely.

1. How many centimeters are there in a meter?

   a. 1
   b. 10
   c. 100
   d. 1,000

2. How many millimeters are there in 2.8 meters?

   a. 28
   b. 280
   c. 2080
   d. 2800

3. The person who received credit for the discovery of the microscope was

   a. Robert Hooke
   b. Anton Van Leeuwenhoek
   c. Gregor Mendel
   d. Francis Clark

4. If you see a cell on the upper edge of your field of view in a microscope and want to "center" it, which one of the following actions will you take? Move the

   a. slide down
   b. slide up
   c. slide left
   d. slide right
   e. objective lens slightly to the left

5. If you see a hazy image in the microscope, which of the following can be eliminated as a cause? There is

   a. dirt on the light source
   b. dirt on the objective lens
   c. grease on the ocular lens
   d. dirt on the slide and coverslip
   e. an object out of focus

6. You have been assigned the reading of a chapter. What is the first thing you must do?

   a. Read the chapter
   b. Pick out key ideas
   c. Look over the titles and headings
   d. Review the chapter

7. While reading a paragraph you came upon a word you did not know. What section in your book would you turn to for help?

   a. Glossary
   b. Appendix
   c. Index
   d. Table of Contents

8. Given an assignment to find all the information in your textbook, relating to the life cycles of animals, which section would you turn to for help?

   a. Appendix
   b. Table of Contents
   c. Glossary
   d. Index

9. You have observed in the forest, short trees have a higher mortality rate than tall trees. Which one of the following is the best explanation? The short trees

   a. freeze more quickly in the winter
   b. have smaller root systems
   c. receive less light
   d. are swayed and damaged by the tall trees

10. Chlorophyll is necessary for photosynthesis because it

   a. takes in water
   b. captures sunlight
   c. takes in oxygen
   d. captures carbon dioxide

11. Four bean plants were grown under identical conditions except for the amount of light. At the end of one week the plants measured as follows:

   Plant A - 5 cm
   Plant B - 3 cm
   Plant C - 4 cm
   Plant D - 7 cm

   Which plant received the greatest amount of Solar Energy?

   a. Plant A
   b. Plant B
   c. Plant C
   d. Plant D

12. Which one of the following best defines Geology? It is the study of

   a. soils
   b. earth's surface
   c. earth's life recorded in rocks
   d. the ocean bottom

Go to next page

13. The plants in your sealed aquarium died, yet the fish are healthy. This is because

    a. they require no oxygen
    b. the surface area is great enough to exchange oxygen and carbon dioxide with the atmosphere
    c. there must be enough algae to keep the oxygen-carbon dioxide cycle going
    d. the bacteria population is large enough to supply the needed oxygen

14. The area referring to all places where living things can exist is called

    a. biosphere
    b. atmosphere
    c. troposphere
    d. stratosphere

15. Which one of the following defines population?

    a. The movement of animals from one place to another
    b. The number of organisms found in a certain area at a given time
    c. Organisms present in the greatest numbers
    d. A group of one kind of organism in a particular community

16. You have observed an increase in the salmon population of a lake. You would expect to see a/an

    a. increase in the smelt population
    b. decrease in the smelt population
    c. stable population of smelts
    d. decrease in the osprey and eagle population
    e. increase in the beaver population

17. Which one of the following shows organisms in competition for the same niche?

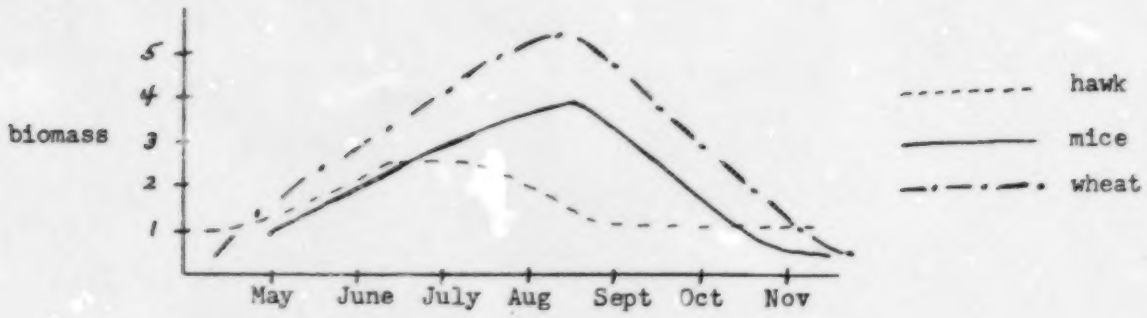
    a. Trout - Pickerel
    b. Bobcat - Coyote
    c. Squirrel-Chipmunk
    d. Partridge - Pheasant

18. In the food chain, human beings are considered to be

    a. herbivores
    b. omnivores
    c. carnivores

Over

19. From the graph below, determine which organism has the greatest biomass.



a. The wheat in May
b. The wheat in August
c. The mice in August
d. The hawks in June

20. The type of ecological community that is found over a large area is called a

a. sere
b. biome
c. habitat
d. population

21. Which one of the following biomes would support the greatest animal population?

a. Tundra
b. Forest
c. Grassland
d. Desert

22. Which one of the following is the most probable cause of the expansion of the desert biomes of the earth?

a. Human populations are leaving the grasslands
b. The grasslands are expanding
c. Rainfall is decreasing in the grasslands
d. The amount of water on earth is decreasing

23. Which of the following statements about ecosystems is correct?

a. Materials are cycled
b. Energy is cycled, materials are lost
c. Both materials and energy are cycled
d. None of the above

24. Which one of the following is most likely to occur if the mature trees in the climax forest are removed?

a. The deer population will decline
b. The young trees that remained will die
c. The deer population will increase
d. The area will become a grassland

25. Which one of the following best describes the changes from field to forest in the southern coastal area of Maine?

a. Grass-trees-shrub-pine-hardwoods
b. Grass-weed-shrub-hardwood-pine
c. Grass-pine
d. Grass-hardwoods

26. In the salt marsh ecosystem, which one of the following factors has the greatest effect on the organism?

a. Length of day
b. Tidal fluctuation
c. Air temperature
d. Annual rainfall

27. Which one of the following best describes the habitat of a deer?

a. Mature forest
b. Young pine forest
c. Young mixed hardwood forest
d. Open fields

28. Which one of the following terms defines where an organism is usually found?

a. Habitat
b. Ground
c. Environment
d. Niche

29. Which one of the following organisms <u>does not</u> leave its habitat?

a. Crab
b. Mussel
c. Fish
d. Coyote

30. Habitat is to coyote as _____ is to man.

a. Community
b. Environment
c. Occupation
d. Society
e. Address

31. Which one of the following is the largest phyla in terms of numbers of species in Maine?

a. Platyhelminthes
b. Arthropoda
c. Vertebrata
d. Spermatophyta
e. Thallophyta

Over

32. In harvesting a field of corn a farmer found that one section had much greater yield of corn than the other sections. In checking his records the previous year, he found the section had been planted in

a. corn
b. peas
c. wheat
d. pumpkin

33. In the winter many of our small lakes have a heavy reduction in their fish populations but the large lakes don't. The most probable reason for this is that the small lakes

a. run out of nitrogen
b. run out of carbon dioxide
c. freeze early
d. become too cold for fish to survive

34. Genus is to species as you are to _____.

a. Country
b. State
c. City
d. School
e. Family

35. Snake is to hibernate as bird is to _____.

a. eat
b. sleep
c. molt
d. migrate

36. Which one of the following animals poses the greatest threat to the white-tailed deer of Maine?

a. Coyote
b. Bobcat
c. Mountain lion
d. Homo sapiens
e. Bald eagle

37. The largest group in the classification of plants is

a. species
b. genus
c. order
d. phylum
e. kingdom

38. The horseshoe crab has remained virtually unchanged for 300,000,000 years, so we can conclude that it

a. has an immunity to mutant causing radiation
b. is well adapted to its environment
c. can withstand environmental changes
d. is adequately supplied with food

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39. In the following, the removal of which item would cause the least disruption of the environment?

a. gulls
b. herring
c. zooplankton
d. diatoms

40. As the Zooplankton increases the _____ decrease(s).

a. water
b. fish
c. carbon dioxide
d. urea
e. oxygen

41. Diatoms remain in the upper 100m of the ocean because they can

a. secrete a glass shell
b. reproduce sexually
c. photosynthesize their own food
d. use carbon dioxide

42. Which one of the following would be the best way to increase the lobster catch?

a. Put food on their feeding grounds
b. Eliminate their natural predators
c. Limit the lobster season
d. Take the small lobsters

43. Which one of the following would be included in the mollusks?

a. Painted turtle
b. Hermit crab
c. Dog whelk
d. Green crab
e. Kelp

44. Which one of the following characteristics of a lobster places it in the arthropod group of animals?

a. No hair
b. Complicated brain
c. Jointed appendages
d. Lays eggs
e. Has only two eyes

Over

Directions: Match the structure in Column II to the food it would most likely gather in Column I by shading the space under the letter of your choice on the answer sheet. Entries in Column II may be used once, more than once, or not at all.

Column I: Food	Column II: Structure
45. Fish	a. Filters
46. Flies	b. Grinding teeth
47. Grass	c. Hooked beak
48. Plankton	d. Short heavy beak
49. Rodents	e. Sticky tongue
50. Seeds	

If you finish before time is called, check your work on this test. Thank you.

Life Science Test Grade 7

TABLE OF SPECIFICATION

Topic	Knowledge or Recall	Higher than Knowledge or Understanding & Thinking	Sub-total	Total
Science Study Skills	5	3	8	
Living and Non-living Factors in the Environment	2	4	6	
Population	2	3	5	
Adaptation of the Organisms	3	4	7	
Community Relationships	4	7	11	
Terrestrial and Marine Environment	4	9	13	
Sub-total	20	30		
Total				50

Corrected Item-Analysis Data Sheet

13

LIFE SCIENCE PRETEST

GRADE 7 FALL, 1980

ITEM #	ITEM DIFFICULTY	ITEM DISCRIMINATION	CHOICES PERCENTAGE SELECTING EACH					
			A	B	C	D	E	OTHERS
1	.67	.40	2.3	15.4	66.9	7.4		8.0
2	.22	-.03	20.9	22.2	18.0	29.3		9.7
3	.40	.08	21.9	39.9	15.4	14.1		8.7
4	.06	.07	36.7	19.9	9.6	5.8	21.5	6.4
5	.09	.21	9.0	8.7	10.0	10.9	55.0	6.4
6	.41	.33	35.7	6.1	41.2	8.4		8.7
7	.77	.41	76.8	1.6	10.9	2.9		7.6
8	.42	.27	10.9	29.3	9.3	42.1		8.4
9	.29	.23	9.3	45.0	29.3	8.4		8.0
10	.29	.31	8.7	28.9	29.3	24.4		8.6
11	.66	.37	6.1	14.8	6.4	65.6		7.0
12	.20	.17	11.6	48.9	19.9	14.5		5.1
14	.37	.36	36.7	40.5	7.7	5.5		9.6
15	.39	.26	9.6	38.9	16.7	27.7		7.0
16	.13	.005	17.7	37.6	12.5	12.5	12.2	7.4
17	.17	.03	15.4	16.7	46.9	13.5		7.4
18	.28	.25	27.3	28.3	35.7			8.7
19	.61	.34	12.9	61.4	7.7	10.3		7.7
20	.18	.15	5.1	18.0	40.5	31.8		4.5
21	.19	.03	6.8	56.9	18.6	10.3		7.4
22	.30	.15	14.5	21.9	30.2	26.4		7.1
23	.31	.20	9.6	15.4	30.9	37.0		7.1
24	.12	-.007	33.1	13.8	11.6	36.3		5.2
25	.18	.16	31.8	34.1	18.0	9.3		6.8
26	.30	.32	5.5	30.2	35.4	22.8		6.1
27	.20	.06	41.8	12.5	20.3	18.6		6.7
28	.18	.08	17.7	13.2	49.8	13.2		6.1

29	.33	.17	9.6	33.4	35.4	15.1		6.4
30	.07	.10	25.1	33.1	13.8	13.2	7.1	7.7
31	.11	.10	18.0	10.9	35.0	15.4	13.5	7.1
32	.09	.08	30.2	9.3	36.7	15.8		8.0
33	.39	.24	7.1	12.9	38.6	35.0		6.4
34	.53	.25	8.4	7.7	9.0	16.4	53.4	5.1
35	.59	.38	11.6	13.8	7.4	59.2		8.1
36	.28	.26	20.6	19.0	16.4	28.3	8.7	7.1
37	.26	.10	22.2	17.0	7.1	22.2	26.0	5.5
38	.41	.29	7.1	30.9	41.2	12.5		8.3
39	.28	.10	27.7	18.6	27.0	19.3		7.4
40	.15	.16	9.3	28.0	18.3	22.2	14.8	7.4
41	.37	.27	10.0	19.0	37.0	23.5		10.6
42	.22	.04	37.9	26.7	22.2	7.4		5.8
43	.14	.11	8.7	24.8	14.1	13.2	32.2	7.1
44	.30	.16	32.2	8.0	29.9	15.4	8.4	6.1
45	.20	.20	34.4	19.3	19.9	5.8	10.3	10.3
46	.53	.29	12.5	8.0	10.3	6.4	52.7	9.9
47	.18	.13	40.5	18.3	10.6	10.3	5.5	14.7
48	.23	.38	23.5	18.3	22.2	15.1	7.4	13.5
49	.15	.16	5.8	40.5	15.4	17.7	10.3	10.3
50	.13	.13	37.6	12.5	10.9	12.9	6.4	19.6

# of students = 311 Mean = 14.33 Standard deviation = 5.60

Reliability = .73

Corrected Item-Analysis Data Sheet

RESPONSIBILITY PRE TEST

GRADE 7

FALL, 1980

ITEM #	ITEM DIFFICULTY	ITEM DISCRIMINATION	CHOICES PERCENTAGE SELECTING EACH					
			A	B	C	D	E	OTHERS
1	.36	.31	18.4	9.1	21.5	11.4	35.6	3.9
2	.80	.29	1.3	4.8	4.0	80.0	7.3	2.7
3	.65	.29	3.8	4.3	6.5	65.4	17.5	2.5
4	.08	.07	25.5	18.5	21.9	7.9	22.8	3.3
5	.15	-.002	17.1	29.1	14.7	13.6	22.5	2.9
6	.38	.16	8.9	11.6	7.9	37.6	32.0	2.0
7	.56	.31	4.5	7.9	56.3	11.8	17.2	2.3
8	.26	.13	16.4	26.0	19.4	27.6	6.8	3.8
9	.28	.12	7.0	14.7	23.7	28.1	22.7	3.8
10	.71	.38	9.9	6.8	6.6	2.8	71.4	2.5
11	.31	.19	9.4	31.1	22.2	7.5	27.5	2.3
12	.49	.38	15.2	49.0	5.0	14.7	12.9	3.1
13	.14	.004	13.7	25.3	22.4	25.2	9.9	3.5
14	.48	.22	9.4	8.9	48.3	23.5	7.5	2.3
15	.26	.31	10.4	41.6	10.6	9.3	25.7	2.5
16	.12	.08	11.8	11.3	10.9	36.3	27.2	2.6
17	.24	.08	19.2	23.8	22.0	11.4	19.9	3.7
18	.15	-.06	14.2	21.4	19.5	15.2	26.5	3.1
19	.38	.32	25.8	5.0	26.2	37.7		5.3
20	.44	.26	7.0	43.9	15.1	16.4	13.6	4.2
21	.48	.36	6.6	47.8	8.6	9.1	24.2	3.6
22	.20	.09	6.5	36.6	24.3	19.7	9.4	3.4
23	.38	.35	38.1	12.7	9.8	11.3	24.7	3.4
24	.35	.35	34.9	18.2	17.9	16.7	9.4	2.8
25	.33	.19	32.9	23.0	21.2	11.3	7.5	4.1
26	.14	-.12	14.1	17.7	23.7	12.6	27.2	4.8
27	.15	.06	14.9	23.2	22.7	23.2	11.4	4.7
28	.58	.44	5.3	17.5	57.8	11.1		8.2
29	.12	-.02	6.1	12.4	20.4	44.5	12.9	3.6
30	.15	.17	15.1	32.0	23.8	11.3	12.4	5.5

31	.23	-.01	23.2	16.6	22.7	16.9	14.9	5.8
32	.51	.43	5.8	10.6	18.5	7.0	50.8	7.3
33	.57	.48	7.9	15.6	57.1	6.8	5.0	7.6
34	.55	.50	8.8	55.3	11.6	7.3	7.1	10.0
35	.59	.48	58.6	4.6	6.5	13.7	9.8	6.8
36	.32	.19	10.9	31.6	7.3	27.6	13.1	9.4
37	.12	.001	12.3	15.7	38.6	20.7	5.3	7.5
38	.62	.35	4.3	9.8	61.9	6.3	10.4	7.3
39	.24	.21	23.8	19.5	17.7	9.6	19.2	10.1
40	.27	.11	14.6	14.9	27.2	12.6	21.5	9.2
41	.41	.42	15.1	16.9	11.8	41.4	7.9	6.9
42	.21	.06	13.4	20.5	30.6	14.6	13.4	7.5
43	.40	.31	9.4	9.9	26.5	39.7	4.8	9.6
44	.25	.02	5.3	46.2	24.7	9.8	3.8	10.2
45	.37	.41	16.1	12.6	36.6	10.8	14.4	9.6
46	.44	.40	44.4	9.9	13.9	15.2	6.0	10.6
47	.17	.10	7.9	32.0	16.7	14.7	18.2	10.4
48	.14	.02	15.4	21.0	13.9	24.0	14.1	11.6
49	.19	.13	9.8	18.9	20.5	13.4	26.2	11.3
50	.14	-.05	14.4	12.6	17.1	18.0	25.5	12.4

SUMMARY STATISTICS

# of students = 604 Mean = 16.84 Standard Deviation = 6.27

Reliability = .77